

CLAIMS

1. An optical component packaging device in combination with an optical component optically coupled to a strip of optical fiber, said strip of optical fiber defining a fiber longitudinal axis, said strip of optical fiber being made of an optical fiber material defining an optical fiber coefficient of thermal expansion, said strip of optical fiber including a fiber core surrounded by a fiber cladding coated with a protective jacket, said strip of optical fiber defining a fiber outer surface, said optical component packaging device comprising :
- 5
- a housing, said housing defining a housing peripheral wall encompassing a housing inner volume, said housing peripheral wall having a housing aperture extending therethrough and leading into said housing inner volume, said housing being made of a housing material defining a housing coefficient of thermal expansion;
 - an intermediate component, said intermediate component being substantially sealingly attached to said housing so as to cover said housing aperture, said intermediate component being made of an intermediate component material defining an intermediate component coefficient of thermal expansion, said intermediate component being provided with a generally encompassing intermediate component channel extending therethrough, said intermediate component channel defining an intermediate channel inner surface and an intermediate channel longitudinal axis;
 - said housing aperture and said intermediate component channel being configured, sized and positioned so as to allow said strip of optical fiber to extend from a position located inside said housing inner volume to a position located outside said packaging device while defining a fiber-to-channel spacing between said fiber outer surface and said intermediate channel inner surface;
 - a sealing component in sealing contact with both said fiber outer surface and said intermediate channel inner surface, said sealing component being made of a sealing component material defining a sealing component coefficient of thermal expansion, said sealing contact of said sealing component with both said fiber outer surface and said intermediate channel inner surface being facilitated by the relationship between said sealing component, said intermediate component and said optical fiber coefficients of thermal expansion.
- 10
- 15
- 20
- 25
- 30
2. A combination as set forth in claim 1 wherein, said sealing contact of said sealing component with said fiber outer surface and said intermediate channel inner surface is

facilitated, at least in part, by a compressive force exerted on said sealing component and generated by the relationship between said sealing component, said intermediate component and said optical fiber coefficients of thermal expansion.

5 3. A combination as set forth in claim 1 wherein, said sealing contact of said sealing component with said fiber outer surface and said intermediate channel inner surface is facilitated, at least in part, by a reduction in the tensile stress at the adhesion interface of said sealing component, said reduction in the tensile stress resulting, at least in part from the relationship between said sealing component, said intermediate component and
10 said optical fiber coefficients of thermal expansion.

4. A combination as set forth in claim 1 wherein, said sealing component coefficient of thermal expansion is at least equal to said optical fiber coefficient of thermal expansion.

15 5. A combination as set forth in claim 1 wherein, said intermediate component coefficient of thermal expansion is at least equal to said sealing component coefficient of thermal expansion.

20 6. A combination as set forth in claim 1 wherein, said intermediate component coefficient of thermal expansion is at least equal to said sealing component coefficient of thermal expansion and said sealing component coefficient of thermal expansion is at least equal to said optical fiber coefficient of thermal expansion.

25 7. A combination as set forth in claim 1 wherein said intermediate component coefficient of thermal expansion is greater than said optical fiber coefficient of thermal expansion and wherein said intermediate component is configured and sized so as to generate a compressive force on said sealing component.

30 8. A combination as set forth in claim 1 wherein, said intermediate component channel defines a sealing section along which said sealing component is in sealing contact with both said fiber outer surface and said channel inner surface, said sealing section defining a sealing section opening area and a sealing section length, the ratio of said sealing section opening area to said sealing section length being minimized so as to reduce water ingress through said sealing component in said sealing section.

9. A combination as set forth in claim 8 wherein, the value of said sealing section opening area is generally close to the value of said optical fiber diameter and the ratio of said sealing section opening area to said sealing section length has a value of approximately 1/10.
10. A combination as set forth in claim 1 wherein, said intermediate component channel defines a sealing section along which said sealing component is in sealing contact with both said fiber outer surface and said channel inner surface, said strip of optical fiber extending in said sealing section being at least partially deprived of said protective jacket over at least a jacketless section thereof, whereby said sealing component contacts at least a portion of said fiber cladding over said jacketless section.
11. A combination as set forth in claim 10 wherein, said jacketless section extends generally throughout said sealing section, said fiber outer surface of said strip of optical fiber extending in said sealing section being deprived of said protective jacket generally over its full length, whereby said sealing component sealingly contacts said fiber cladding generally over the full length of said sealing section.
12. A combination as set forth in claim 1 wherein, said packaging device is provided with a sealing component insertion means for allowing insertion of said sealing component into said intermediate component channel.
13. A combination as set forth in claim 12 wherein, said intermediate component channel defines a sealing section along which said sealing component is in sealing contact with both said fiber outer surface and said channel inner surface; said intermediate component channel also defining a guiding section extending from said sealing section; said sealing component insertion means including an insertion channel formed in said intermediate component, said insertion channel extending from a position located outside said packaging device to a position wherein it merges with said guiding section.
14. A combination as set forth in claim 1 wherein, said intermediate component is provided with an intermediate component attachment section and said housing is provided with a housing attachment section, said intermediate component attachment

section and said housing attachment section being configured, sized and positioned so as to be in a generally overriding relationship relative to one another, said intermediate component being attached to said housing by a retaining force exerted between said intermediate component attachment section and said housing attachment section.

5

15. A combination as set forth in claim 14 wherein, said retaining force is generated, at least in part, by an adhesive link created by an intermediate component -to- housing adhesive material positioned between said intermediate component attachment section and said housing attachment section.

10

16. A combination as set forth in claim 15 wherein, said retaining force is further generated, at least in part, by a retaining pressure resulting from a difference between said intermediate component coefficient of thermal expansion and said housing coefficient of thermal expansion.

15

17. A combination as set forth in claim 16 wherein, said intermediate component attachment section and said housing attachment section are configured so as to collaborate in creating a filling receiving volume, said filling receiving volume being substantially filled with an intermediate component-to-housing filling material, said intermediate component -to- housing filling material having adhesive properties and being in substantially sealing contact with at least a portion of both said intermediate component attachment section and said housing attachment section.

20

18. A combination as set forth in claim 16 wherein, said intermediate component attachment section and said housing attachment section are configured so as to collaborate in creating an filling receiving volume, said filing receiving volume being substantially filled with a generally compliant intermediate component-to-housing filling material, said intermediate component -to- housing filling material being in substantially sealing contact with at least a portion of both said intermediate component attachment section and said housing attachment section.

25

30

19. A combination as set forth in claim 1 further comprising an alignment means for aligning said strip of optical fiber relative to said intermediate component channel so that

said fiber longitudinal axis extends in a generally parallel relationship relative to said intermediate channel longitudinal axis.

5 20. A combination as set forth in claim 19 wherein, said alignment means includes a supporting component mounted within said housing inner volume, said supporting component defining a supporting surface for supporting a supported section of said strip of optical fiber.

10 21. A combination as set forth in claim 20 wherein, at least a portion of said supported section is secured to said supporting surface.

15 22. A combination as set forth in claim 20 wherein, said supporting component defines a pair of supporting surfaces for supporting a corresponding pair of supported sections of said strip of optical fiber, said supporting surfaces being in a spaced relationship relative to each other and defining a clearance section therebetween, said strip of optical fiber defining an unsupported section extending between said supported sections and being substantially in register with said clearance section, at least a portion of each of said supported sections being secured to a corresponding supporting surface.

20 23. A combination as set forth in claim 22 wherein, said clearance section is configured, sized and positioned so as to allow said unsupported section to move in a direction substantially perpendicular to said fiber longitudinal axis over a predetermined range without contacting said intermediate component.

25 24. A combination as set forth in claim 20 wherein, said supporting component is mechanically coupled to said housing by a supporting component-to-housing coupling means so as to allow a relative movement between said supporting component and said housing in a direction generally parallel to said fiber longitudinal axis.

30 25. A combination as set forth in claim 24 wherein, said supporting component-to-housing coupling means includes a component-to-housing coupling layer of substantially resilient adhesive material bounding said supporting component to said housing.

26. A combination as set forth in claim 1, further comprising a getter component, said getter component being positioned within said housing inner volume for absorbing moisture and contaminants contained therein.
- 5 27. A combination as set forth in claim 1 wherein, said housing peripheral wall and said intermediate component are plated with at least a layer of nickel and gold.
- 10 28. A combination as set forth in claim 1 further comprising a strain relief sleeve mounted over a distal end of said intermediate component for limiting the radial deflection of a section of said strip of optical fiber located outside said intermediate component adjacent said distal end thereof.
- 15 29. A combination as set forth in claim 1 further comprising a clearance means for creating a predetermined clearance adjacent a section of said strip of optical fiber located inside said housing inner volume, said predetermined clearance allowing lateral deflection of the optical component and adjacent strips of optical fiber under dynamic excitation with reduced risks of contacting adjacent structures.
- 20 30. An optical component packaging device for protectively enclosing an optical component optically coupled to a strip of optical fiber, said strip of optical fiber defining a fiber longitudinal axis, said strip of optical fiber being made of an optical fiber material defining an optical fiber coefficient of thermal expansion, said strip of optical fiber including a fiber core surrounded by a fiber cladding coated with a protective jacket, said strip of optical fiber defining a fiber outer surface; said optical component packaging device comprising:
- 25 - a housing, said housing defining a housing peripheral wall encompassing a housing inner volume, said housing peripheral wall having a housing aperture extending therethrough and leading into said housing inner volume, said housing being made of a housing material defining a housing coefficient of thermal expansion;
- 30 - an intermediate component, said intermediate component being substantially sealingly attached to said housing so as to cover said housing aperture, said intermediate component being made of an intermediate component material defining an intermediate component coefficient of thermal expansion, said intermediate component being provided with a generally encompassing intermediate component channel extending

therethrough, said intermediate component channel defining an intermediate channel inner surface and an intermediate channel longitudinal axis;

- said housing aperture and said intermediate component channel being in communication with each other so as to allow said strip of optical fiber to extend from a position located inside said housing inner volume to a position located outside said packaging device;

- a sealing component in sealing contact with said intermediate channel inner surface, said sealing component being made of a sealing component material defining a sealing component coefficient of thermal expansion;

- said intermediate component coefficient of thermal expansion being greater than said sealing component coefficient of thermal expansion;

whereby, said sealing component is in sealing contact with both said fiber outer surface and said intermediate channel inner surface, said sealing contact of said sealing component with both said fiber outer surface and said intermediate channel inner surface being facilitated by the relationship between said sealing component, said intermediate component and said optical component coefficients of thermal expansion.

31. An optical component packaging device as recited in claim 30 wherein, said sealing contact of said sealing component with said fiber outer surface and said intermediate channel inner surface is facilitated, at least in part, by a compressive force exerted on said sealing component and generated by the relationship between said sealing component, said intermediate component and said optical component coefficients of thermal expansion.

32. . An optical component packaging device as recited in claim 30 wherein, said sealing contact of said sealing component with said fiber outer surface and said intermediate channel inner surface is facilitated, at least in part, by a reduction in the tensile stress at the adhesion interface of said sealing component, said reduction in the tensile stress resulting, at least in part from the relationship between said sealing component, said intermediate component and said optical component coefficients of thermal expansion.

33. An optical component packaging device as recited in claim 30 wherein, said intermediate component channel defines a sealing section, said sealing section defining

a sealing section opening area and a sealing section length, the ratio of said sealing section opening area to said sealing section length being minimized so as to reduce water ingress through said sealing component in said sealing section.

- 5 34. An optical component packaging device as recited in claim 30 wherein, said intermediate component is provided with an intermediate component attachment section and said housing is provided with a housing attachment section, said intermediate component attachment section and said housing attachment section being configured, sized and positioned so as to be in a generally overriding relationship relative to one
10 another, said intermediate component being attached to said housing by a retaining force exerted between said intermediate component attachment section and said housing attachment section.

15

20